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the quality of the concrete used, and takes place without interruption for the entire length of the bow, or by individual sections if the plan provides for such. The layers are to be poured radially (like arch stones), i.e., approximately perpendicular to the direction of the force of the arch, and tamped perpendicular to the radial cross section approximately in the direction of the force of the arch.

In arches with less camber, where pouring the layers in this manner is not practical, they are to be poured perpendicular to the radial cross section of the arch, i.e., concentric with the form, and tamped perpendicular to it.

44. In order to prevent the occurrence of cracks, resulting either from temperature changes or contraction in setting, expansion joints are to be provided at intervals, with a maximum interval of 40 meters, in the long sides of concrete or reinforced concrete structures, and in those places where the foundations might be unequally loaded in event of vibrations. These joints are made by inserting paperboard, sheet metal, or a board to be removed later and replaced by an elastic substance. In every case where such joints are impracticable because of the special style of the structure, the influence of temperature variations and contraction is to be considered in the structural computation.

45. Straight and projecting external members which could be damaged are to be beveled or rounded off; when they occur on streetsides, particularly those with heavy traffic, they are to be covered with iron, or otherwise suitably protected from damage. In such cases, the material used for securing projections must be nonflammable. Inside the structure all corners of less than 90 degrees are to be beveled.

46. When working on foundations in dry ground, the ground surface is to be leveled and covered with a 5- to 10-cm-thick layer of sand before pouring the concrete. In wet ground, a solid bedding is to be provided - according to the quality of the soil - out of tamped sand or gravel layers until the subsoil is completely compact. On such foundations, the concrete is poured in layers parallel to the ground surface. The aforementioned rules apply for tamping.

47. Boxes, sacks, or tubes are used in concreting under water. With a large quantity of water or a current, the work site must be surrounded by a tight wall; when using boxes, in order to prevent dissociation of the concrete constituents and washing out of the concrete, care must be taken that the concrete does not fall freely under water, and that the water in the construction pit is not disturbed.

Concreting with tubes is done gradually so that the concrete is laid in continuous layers. Simply spreading the concrete up through the entire depth of the water, and dissociation of the concrete in the tube are not permissible, and the tube must therefore be full of concrete before concreting as well as during the operation. The concrete is to be poured in 40-cm layers, and there are also footings to be arranged, varying in thickness with the individual layers and perpendicular to the direction of the spreading. When first filling the tubes, the concrete is poured into them from boxes.

The water may not be pumped out until the concrete has hardened sufficiently.

Concrete and reinforced-concrete members such as stones for facing, border stones, posts, beams of short span, etc., may be made in a special shop and brought to the work site in a finished condition - this with permission of construction and supervisory authorities.

D. Protection of Fresh Concrete and Removal of Forms and Props

49. After concreting is finished, the concrete masonry is to be protected from rain and for two weeks thereafter must be secured against

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too rapid drying-out and against the damaging effects of sun, wind, and frost. This period may be altered with the approval of the authorities.

Arches, bows, roofs, and retaining walls are to be protected from excess heat of the sun until final filling because of the great variations in day and night temperatures. For this purpose, in event of drought or strong heat, the finished member is to be covered with a thin layer of sand, straw mats, excelsior, or something similar, and kept damp.

50. For at least three days after completion, the members must be protected against any concussion or other harm, and stepping on, landing, etc. must be forbidden. With permission of the authorities, this period may be shortened for massive parts and those resting on a solid foundation.

51. Forms are removed upon permission from the authorities after sufficient hardening of the concrete and according to the weather, the amount of water used, and other conditions, but in no case prior to the expiration of the following periods (to start upon completion of concreting):

- a. Three days - removal of upper casing from bows and arches
- b. Five days - removal of side casing from beams, bows and arches
- c. Seven days - removal of casing from piles and columns.

The requisite safety measures for protection of the fresh concrete are to apply after the forms are removed as well as during removal.

52. Forms and scaffolding are detached and removed upon permission of the authorities, but only upon the certainty that the concrete is sufficiently hardened and in no case before the expiration of the following periods (to start upon completion of concreting):

- a. Two weeks - for beams, bows, and floors with spans of no more than 3 meters from axis to axis;
- b. Three weeks - for similar members with spans of 3 - 6 meters;
- c. Four weeks - for members with spans of over 6 meters.

For large spans and members with a large cross-section these periods can be lengthened according to circumstances up to 6 weeks by order of the authorities. Particular attention is required in removing forms from those members which have to take up the full computed load immediately.

In removing forms, the posts and forms first are to be loosened. Hammering and tearing off nailed form parts is forbidden and any concussion is not permissible. The lowering and removal of the scaffolding must be done in the presence of the authorities.

NOTE: In freezing weather, the periods in sections 51 and 52 increase at least by that interval between the end of concreting and the recurrence of an exterior temperature of over 5 degrees C.

53. After removal of the props and forms, the authorities decide on committing the load to the construction members, e.g., the filling-in of retaining walls, the covering of arches, etc.

In no case may the permissible stress be placed on the concrete before a lapse of four weeks after the concreting is finished.

IV FINISHING

A. Exterior Surfaces

54. When no plan is specified, exterior surfaces are finished with a cement flat-coat of at least 1 part cement and 2 parts sand (1:2). This work is to be done directly after removal of the forms.

B. Carrying Off Rainwater on the Exterior Surfaces of Concrete and Reinforced Concrete

55. All exterior surfaces which might come in contact with rain

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water or water from melting snow must be sloping and completely smooth. Precautionary measures must be taken in the case of ridges and projections.

V TEST LOADING OF CONCRETE AND REINFORCED CONCRETE STRUCTURES

A. General Directives

56. Test loading is to be done when called for in the plan or upon request of the authorities, independently of the general test provisions for bridges, private structures, etc.

57. The trials occur in the presence of the authorities and are an exhaustive test of the structure during and after loading. Records are made of all data, conclusions, etc., and include authorization for release of the building.

58. Test loads are to be those designated in the plan as the overall greatest.

The greatest deflection during the test may not exceed:

- a. 1/1000 of the computed span of freely supported beams and slabs
- b. 1/1800 of the computed span of continuous or frame girders
- c. 1/2500 of the span for bows.

Permanent deflection may not exceed 30 percent of the temporary.

Test loads are to be easily moveable and should facilitate observation of changes in form in the parts tested, etc.

Measurement of deflection is to be made with apparatus having a reading of at least 1/10 millimeters.

B. Tests on Bridges

59. At the time of the test, the age of the concrete must be:

- a. at least 1 month for bridges under 6 meters
- b. at least 1½ months for bridges 6-15 meters
- c. at least 2 months for bridges of particular importance and a span of over 15 meters, or, if this does not apply, for very high bridges, and in all cases when requested by the authorities.

NOTE: The age of the concrete is counted from the ending of concreting during only those periods when an air temperature of plus 5 degrees C prevailed. If the authorities so desire, the period may be lengthened, not to exceed three months.

60. Both static and dynamic tests are to be made.

61. In static tests, loads are to approach as nearly as possible the size and location actually computed. When this is not possible, comparisons are to be made with data obtained. In tests on all structures, the load period may not be less than 2 hrs nor exceed 24 hours. Subsequent increase in deflection is not permissible.

For every rib or girder of a bow composed of equal bow-elements, or at least at two points of the same cross-section, the temporary and permanent deflection are to be determined. This applies also to any other bridge whether it be a full arch, slab beam, or any other continuous or non-continuous type.

In jointed bridges, the deflection at the joints is to be ascertained.

In determining the deflections, some sinking of the abutments is also to be considered. If permanent deflection exceeds that in section 58, the final deflection figure is taken as that measured after 24 hours subsequent to removal of the test load.

In pile bridges with several spans, the piles are to be tested for stability simultaneously with the test loading of the longitudinal supports, and in case of unfavorable load distribution they are to be ex-

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examinated for settling and alignment.

62. Dynamic tests for rolling loads on railroad bridges are to be based on a speed of 20-30 verst (21-32 kilometers) per hour or more, but within the limits set by the railroad authorities. The train is also to be run slowly across the bridge and stopped at the test points where the greatest static deflections come into question, taking their value as of that time.

The length of the testing train must be double the length of single-span bridges, and at least the length of the bridge having a number of spans.

Maximum deflections under dynamic test are to be treated as in the static test. The trial run may take place only after the structure is in suitable condition, and is to be executed independently of other tests.

63. In static tests on ordinary bridges, loads are to be introduced equally distributed and without any concussions to cause vibrations greater than the bridge has to stand when in service.

C. Tests on Private Structures

64. In cases where construction methods have been satisfactory and concrete test has shown sufficient strength, the stability test may be excluded. However, the authorities may require tests on any individual part in event of unsatisfactory load distribution.

65. In all cases where tests are required by the authorities, the age of the concrete may not be less than one month.

NOTE. Age is calculated from the ending of concreting on, exclusive of periods when the air temperature was less than 5 degrees.

Upon occurrence of considerable form changes or cracks in an individual part of the floor or any other member, the test is to be extended to include the entire floor and all its parts. The effective period of the test load for each individual load placement must be at least one half hour after the appearance of the greatest deflection; in other respects, section 61 applies. Permissible deflection is determined according to section 55.

66. Deviations herefrom may be decided by authorities.

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